

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 28 MAR 2006

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Applicant's or agent's file reference 28615	FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/IL2005/000010	International filing date (day/month/year) 04.01.2005	Priority date (day/month/year) 15.01.2004	
International Patent Classification (IPC) or national classification and IPC INV. H01S5/068			
Applicant ELOP ELECTROOPTICAL INDUSTRIES LTD. et al			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 3 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input checked="" type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 11.12.2005		Date of completion of this report 27.03.2006	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer Meacher, D Telephone No. +49 89 2399-5876	



**INTERNATIONAL PRELIMINARY REPORT
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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-12 as originally filed

Claims, Numbers

1-14 received on 11.12.2005 with letter of 11.12.2005

Drawings, Sheets

1/9-9/9 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation to restrict or pay additional fees, the applicant has:
- ☐ restricted the claims.
 - ☐ paid additional fees.
 - ☐ paid additional fees under protest.
 - ☒ neither restricted nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
 - ☒ not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☐ all parts.
 - ☒ the parts relating to claims Nos. 1-6 .

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement
- | | | |
|-------------------------------|-------------|-----|
| Novelty (N) | Yes: Claims | 1-6 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-6 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-6 |
| | No: Claims | |
2. Citations and explanations (Rule 70.7):
- see separate sheet**

A. Item V Lack of unity of invention (Rules 13.1 and 13.2 PCT)

This authority considers that there are two inventions covered by the following groups of claims:

Group I: Claims 1-6 directed to a constant current power supply comprising means to protect a load from over-current spikes, wherein a second feedback element associated with both the load and the shunt paths works together with a current draining element in a shunt path to provide current regulation of the load path based on the current in the shunt path.

Group II: Claims 7-14 directed to a power supply for charging a capacitive load comprising an inductance connected in series with the capacitive load and feedback means for controlling the series impedance of the capacitive load and the inductance to maintain the charging current of the capacitive load at a predetermined level.

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

Document D1 is regarded as representative of the closest prior art to the subject-matter of claim 1 and teaches (figure 5; paragraphs [0005]-[0008], [0029]-[0031]) a high-speed power supply arrangement suitable for laser diodes comprising:

- a. a variable voltage power supply *415*,
- b. a load path for carrying a laser diode *LD1420*,
- c. a shunt path (containing *M1520* and *M2522*) connected in parallel with said load path,
- d. a current draining element (*M1520* and *M2522*) for switching said shunt path, said current draining element being associated via a first feedback element *R3440* with said variable voltage power supply *415* such that current drained by said current draining element provides first feedback control of a voltage level of said

variable voltage power supply (paragraph [0031]),

Remark The current drained by said current draining element determines the potential difference appearing across *R2435* and *M3518* and hence the feedback voltage appearing at *R3440*.

e. and a voltage operated (the voltage appearing across *R1425*) second feedback element *U4540* associated with both said load path and said shunt path to provide a second feedback control of said current draining element to drain current via said current draining element in response to current changes at said load *LD1420*, said voltage operated second feedback element thereby working together with said current draining element to provide current regulation of said load path.

Therefore the special technical feature of claim 1 being that technical feature making a contribution over the content of the prior art concerns a voltage operated second feedback element that works together with said current draining element to provide current regulation of said load path from said shunt path. This feature addresses the technical problem of providing a constant current power supply comprising means to protect a load from over-current spikes not requiring a series MOSFET transistor in the load path.

The special technical features of claims 7-14 relate to: *a load capacitance to be charged, a serially connected inductive component contributing to a serial frequency dependent impedance, and a variable frequency source being controllable to reduce frequency during charging of said capacitor, thereby to reduce said frequency dependent impedance and maintain a level of charging current to said load capacitance.* These features address the technical problem of providing a circuit for charging a capacitor at a controllable charging current.

Therefore it appears that the two groups of claims set out above do not have a common special technical feature, nor does it appear that their respective special technical features are *corresponding* because they solve the two distinct technical problems set out above. Thus it appears that neither do the two groups of claims share a common general inventive concept and the application consequently does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

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No additional fees having been paid in response to the invitation set out in the form IPEA/405 communicated to the applicant on 27.01.2006 within the time limit indicated therein, the remainder of this International Preliminary Report on Patentability has been drawn according to Article 34(3)(c) PCT up for the invention first mentioned in the claims corresponding to claims 1-6.

B. Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: US 2003/063641 A1 (JOHNSON RONALD E) 3 April 2003

2. Claim 1 is considered to meet the requirements of the PCT with respect to novelty and inventive step for the following reasons:

Document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (figure 5; paragraphs [0005]-[0008], [0029]-[0031]):

a high-speed power supply arrangement suitable for laser diodes comprising:

- a. a variable voltage power supply *415*,
- b. a load path for carrying a laser diode *LD1 420*,
- c. a shunt path *M1 520* connected in parallel with said load path,
- d. a current draining element for switching said shunt path *U4 540*, said current draining element being associated via a first feedback element *R3 440* with said variable voltage power supply *415* such that current drained by said current draining element provides first feedback control of a voltage level of said variable voltage power

supply (paragraph [0031]), and

Remark The current drained by said current draining element determines the potential difference appearing across *R2 435* and *M3 518* and hence the feedback voltage appearing at *R3 440*.

e. a voltage operated (the voltage appearing across *R1 425*) second feedback element *U4 540* associated with both said load path and said shunt path to provide a second feedback control of said current draining element to drain current via said current draining element in response to current changes at said load *LD1 420*.

The subject-matter of claim 1 differs from this known high speed power supply arrangement in that:

said voltage operated second feedback element works together with said current draining element to provide current regulation of said load path from (*a voltage derived from the current in*) said shunt path

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The technical effect of the invention is that according to claim 1, current regulation of the variable voltage power supply is provided by voltage feedback from the low-current shunt path instead of by voltage feedback from a path in which both load and shunt currents flow, so that no high power transistor is required in the current return path.

The problem to be solved by the present invention may be regarded as how to modify the high speed current regulated power supply arrangement of the closest prior art so that the need for a high power transistor in the current return path is removed.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

Nothing in the prior art to hand suggests deriving the feedback voltage for controlling the output of the variable voltage power supply on the basis of the current flowing in the shunt path alone.

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3. Claims 2-6 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

CLAIMS:

1. A high speed power supply arrangement suitable for laser diodes, comprising:
 - a) a variable voltage power supply,
 - b) a load path for carrying a laser diode,
 - c) a shunt path connected in parallel with said load path,
 - d) a current draining element for switching said shunt path, said current draining element being associated via a first feedback element with said variable voltage power supply such that current drained by said current draining element provides first feedback control of a voltage level of said variable voltage power supply, and
 - e) a voltage operated second feedback element associated with both said load path and said shunt path to provide second feedback control of said current draining element to drain current via said current draining element in response to current changes at said load, said voltage operated second feedback element thereby working together with said current draining element to provide current regulation of said load path from said shunt path.
2. The arrangement of claim 1, wherein said first feedback control is relatively slow and said second feedback control is faster than said relatively slow first feedback control.
3. The arrangement of claim 1, wherein said first feedback control is set with a response rate suitable for a DC-DC voltage level converter.
4. The arrangement of claim 1, wherein said second feedback control is set with a response rate in the microsecond order of magnitude.
5. The arrangement of claim 1, wherein said current draining element is a transistor.
6. A method of current regulation to provide constant current to a load comprising:

providing a power source having a controllable output voltage level, providing current to said load from said voltage power source,
connecting a current draining element in parallel with said load, and arranging:
relatively fast feedback control from said load to operate said current draining element to drain over current from said load, and
relatively slow feedback control responsive to current drained by said current draining element to control said output voltage level of said power source said relatively slow feedback control working together with said relatively fast feedback control to provide current regulation of a path of said load from a path shunting said load.

7. A circuit arrangement for charging a capacitance comprising:
a load capacitance to be charged,
a serially connected inductive component contributing to a serial frequency dependent impedance,
a variable frequency source for supplying charging current at a variable frequency, and
a current measurement device for measuring said charging current and using said measurement to provide a feedback signal to said variable frequency source, thereby to control said variable frequency to reduce said frequency,
said variable frequency source being controllable to reduce frequency during charging of said capacitor, thereby to reduce said frequency dependent impedance and maintain a level of charging current to said load capacitance.

8. The circuit arrangement of claim 7, further comprising a serially connected capacitive component to contribute to said serial frequency dependent impedance.

9. The circuit arrangement of claim 7, wherein said variable frequency source comprises pulse width modulation.

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10. The circuit arrangement of claim 7, wherein said load capacitance is connected to said serial component via a rectifying bridge.

11. The circuit arrangement of claim 7, wherein said feedback signal is modified to stabilize said charging current at a constant level whilst said load capacitance is charging.

12. A method of providing constant current charging of a capacitive load comprising:

arranging said capacitive load in series with a reactive impedance comprising at least an inductive element,

providing current at a controllable supply frequency,

measuring an actual charging current of said capacitive load,

using measured changes in said charging current to control said frequency thereby to adjust said reactive impedance so as to keep said charging current substantially constant.

13. The method of claim 12, wherein said reactive impedance further comprises a capacitive element in series with said inductive element.

14. The method of claim 12, comprising arranging said capacitive load with a rectifying bridge so that said capacitive load receives substantially DC charging current irrespective of said supply frequency.